

Claims

What is claimed is:

1. A method of controlling the movement of a work machine arm having a series of hydraulic cylinders operatively engaged with the work machine arm, comprising:
 - receiving a signal from an input device to change the position of the work machine arm;
 - determining an extension amount of one or more of the series of hydraulic cylinders; and
 - changing the extension amount of one or more of the series of hydraulic cylinders to effect the change in the position of the work machine arm, wherein the changes in the extension amount of the one or more of the series of hydraulic cylinders are ordered based on a pre-selected priority of movement.
2. The method of claim 1, wherein the pre-selected priority of movement prevents the extension amount of one or more of the series of hydraulic cylinders from changing until the extension amount of another of the series of hydraulic cylinders is substantially fully extended or retracted.
3. The method of claim 1, wherein the pre-selected priority of movement includes substantially fully extending or retracting a stick cylinder before changing one of the extension amount of an extendable stick cylinder and the reach of a work implement relative to a stick associated with the stick cylinder.
4. The method of claim 1, wherein determining an extension amount of the series of hydraulic cylinders includes:

determining the extension amount of a stick cylinder with a stick sensor;

determining the extension amount of an extendable stick cylinder with an extendable stick sensor; and

determining the extension amount of a work implement cylinder with a work implement sensor.

5. The method of claim 4, wherein the pre-selected priority of movement includes changing the work implement cylinder extension to increase or decrease the reach of a work implement relative to a stick after the stick cylinder is substantially fully extended or retracted.

6. The method of claim 5, wherein the pre-selected priority of movement includes changing the extendable stick cylinder extension amount after the work implement cylinder is substantially fully extended or retracted.

7. The method of claim 1, wherein the pre-selected priority of movement for an extension of the work machine arm is different than the pre-selected priority of movement for a retraction of the work machine arm.

8. The method of claim 1, further including selecting a mode from a mode selector to change the pre-selected priority of movement.

9. The method of claim 1, wherein effecting the change in position includes transitioning movement between the one or more of the series of hydraulic cylinders by ramping down the velocity of the one or more of the series of hydraulic cylinders while ramping up the velocity of another one or more of the series of hydraulic cylinders.

10. A system for controlling the movement of a work machine arm having a series of hydraulic cylinders operatively engaged with the work machine arm, comprising:

an input device operable to generate a signal to change the position of the work machine arm;

at least one sensor associated with one or more of the series of hydraulic cylinders for determining an extension amount of the one or more of the series of hydraulic cylinders; and

a control module adapted to receive the signal from the input device and to change the extension amount of one or more of the series of hydraulic cylinders to effect the change in the position of the work machine arm, wherein the changes in the extension amount of the one or more of the series of hydraulic cylinders are ordered based on a pre-selected priority of movement.

11. The system of claim 10, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and wherein the pre-selected priority of movement allows the extension amount of one or more of the series of hydraulic cylinders to change after the extension amount of another of the series of hydraulic cylinders is substantially fully extended or retracted.

12. The system of claim 10, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and the pre-selected priority of movement fully extends or retracts a stick cylinder before changing one of the extension amount of an extendable stick cylinder and the reach of a work implement relative to a stick associated with the stick cylinder.

13. The system of claim 10, further including:

a stick sensor associated with a stick cylinder for determining the extension amount of the stick cylinder;

an extendable stick sensor associated with an extendable stick cylinder for determining the extension amount of the extendable stick cylinder;
and

a work implement sensor associated with a work implement cylinder for determining the extension amount of the work implement cylinder.

14. The system of claim 13, further including:

a work implement associated with the work implement cylinder;

and

a stick associated with the stick cylinder, wherein the control module is adapted to change the work implement cylinder extension to increase or decrease the reach of the work implement relative to the stick after the stick cylinder is substantially fully extended or retracted.

15. The system of claim 14, wherein the control module is adapted to change the extendable stick cylinder extension amount after the work implement cylinder is substantially fully extended or retracted.

16. The system of claim 10, wherein the pre-selected priority of movement for an extension of the work machine arm is different than the pre-selected priority of movement for a retraction of the work machine arm.

17. The system of claim 10, further including a mode selector adapted to change the pre-selected priority of movement.

18. The system of claim 17, wherein the mode selector changes the pre-selected priority of movement for different types of work implements.

19. The system of claim 17, wherein the mode selector changes the pre-selected priority of movement for different digging projects.

20. The system of claim 10, wherein the control module is adapted to effect the change in position by transitioning movement between the one or more of the series of hydraulic cylinders by ramping down the velocity of the one or more of the series of hydraulic cylinders while ramping up the velocity of another one or more of the series of hydraulic cylinders.

21. An apparatus for controlling the movement of a work machine arm having a series of hydraulic cylinders operatively engaged with the work machine arm, comprising:

means for receiving a signal from an input device to change the position of the work machine arm;

means for determining an extension amount of one or more of the series of hydraulic cylinders; and

means for changing the extension amount of one or more of the series of hydraulic cylinders to effect the change in the position of the work machine arm, wherein the changes in the extension amount of the one or more of the series of hydraulic cylinders are ordered based on a pre-selected priority of movement.

22. The apparatus of claim 21, wherein the pre-selected priority of movement allows the extension amount of one or more of the series of

hydraulic cylinders to change only after the extension amount of another of the series of hydraulic cylinders is substantially fully extended or retracted.

23. The apparatus of claim 21, wherein the pre-selected priority of movement includes substantially fully extending or retracting a stick cylinder before changing one of the extension amount of an extendable stick cylinder and the reach of a work implement relative to a stick associated with the stick cylinder.

24. The apparatus of claim 21, wherein determining an extension amount of the series of hydraulic cylinders includes:

means for determining the extension amount of a stick cylinder with a stick sensor;

means for determining the extension amount of an extendable stick cylinder with an extendable stick sensor; and

means for determining the extension amount of a work implement cylinder with a work implement sensor.

25. The apparatus of claim 24, wherein the pre-selected priority of movement includes changing the work implement cylinder extension to increase or decrease the reach of a work implement relative to a stick after the stick cylinder is substantially fully extended or retracted.

26. The apparatus of claim 25, wherein the pre-selected priority of movement includes changing the extendable stick cylinder extension amount after the work implement cylinder is substantially fully extended or retracted.

27. A controller for controlling the movement of a work machine arm having a series of hydraulic cylinders operatively engaged with the work machine arm, comprising:

an input device operable to send a control signal to change the position of the work machine arm;

a series of valves operably associated with the series of hydraulic cylinders; and

a control module adapted to receive the control signal from the input device, and adapted to send a signal to the series of valves to change the extension amount of one or more of the series of hydraulic cylinders to effect the change in the position of the work machine arm, wherein the changes in the extension amount of the one or more of the series of hydraulic cylinders are ordered based on a pre-selected priority of movement.

28. The controller of claim 27, further including:

a stick sensor associated with a stick cylinder for determining the extension amount of the stick cylinder;

an extendable stick sensor associated with an extendable stick cylinder for determining the extension amount of the extendable stick cylinder; and

a work implement sensor associated with a work implement cylinder for determining the extension amount of the work implement cylinder.

29. The controller of claim 27, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and the pre-selected priority of movement allows the extension amount of one or more of the series of hydraulic cylinders to change after the extension amount of another of the series of hydraulic cylinders is substantially fully extended or retracted.

30. The controller of claim 27, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and the pre-selected priority of movement substantially fully extends or retracts a boom cylinder and a stick cylinder before changing one of the extension amount of an extendable stick cylinder and the reach of a work implement relative to a stick associated with the stick cylinder.

31. A work machine comprising:
a work machine arm including,
a boom having a boom cylinder,
a stick pivotally connected to the boom, the stick having a stick cylinder,
an extendable stick slidably connected to the stick, the extendable stick having an extendable stick cylinder, and
a work implement pivotally connected to the extendable stick, the work implement having a work implement cylinder;
a stick sensor associated with the stick cylinder for determining the extension amount of the stick cylinder;
an extendable stick sensor associated with the extendable stick cylinder for determining the extension amount of the extendable stick cylinder;
a work implement sensor associated with the work implement cylinder for determining the extension amount of the work implement cylinder;
an input device operable to generate a signal to change the position of the work machine arm; and
a control module adapted to receive the signal from the input device and to change the extension amount of one or more of the hydraulic cylinders to effect the change in the position of the work machine arm, wherein

the changes in the extension amount of the hydraulic cylinders are ordered based on a pre-selected priority of movement.

32. The system of claim 31, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and wherein the pre-selected priority of movement allows the extension amount of one or more of the hydraulic cylinders to change only after the extension amount of another of the hydraulic cylinders is substantially fully extended or retracted.

33. The system of claim 31, wherein the control module includes a memory adapted to store the pre-selected priority of movement, and the pre-selected priority of movement substantially fully extends or retracts the stick cylinder before changing one of the extension amount of the extendable stick cylinder and the reach of the work implement relative to the stick.